Roma, 14/5/99

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IHRA Working Group on Advanced Offset Frontal Crash Protection.

Please find here enclosed the minutes of the fourth meeting of the Working Group, held in London on 16-17th February 99.

Sincerely yours,

Claudio Lomonaco

INTERNATIONAL HARMONIZED RESEARCH AGENDA (I.H.R.A.)

Rome, 15/3/99

STATUS REPORT ON THE ADVANCED OFFSET FRONTAL CRASH PROTECTION GROUP
(Based on the results of the meeting held in London on 16-17 February 1999)

Participants: C. Lomonaco (Chairman, Ministry of Transport of Italy), R. Lowne (EEVC), A. Lie (EEVC), K. Seyer (Federal Office of Road Safety Australia), A Hobbs (IHRA Compatibility), P O'Reilly (IHRA, Compatibility), T. Hollowell (NHTSA), C. Newland (IHRA, Side Impact), Y. Kadotani (JAMA), G. Nusholtz (OICA), P. Fay (ACEA/OICA), E. Gianotti (Secretary of the Group).

INTRODUCTION

The chairman, after welcoming the participants, gave a brief résumé of the contents of the past meeting and asked for comments concerning documents AFC13 and 14 distributed by NHTSA at the last session.

NHTSA announced that it is setting more complex and stringent biomechanical criteria, such as combined thoracic index and neck criteria.
Comments on the NPRM have being received by NHTSA from different participants on this issue, such as, Insurance Companies and Auto makers particularly regarding the combined new criteria. A status report on conclusions of these discussions will be published by mid-march.

Explaining briefly the document AFC13, NHTSA reported the experience of the agency with respect to possible procedures and the lead time expected to finalize the research. Compatibility is being taken into consideration. The commitment is to design a new procedure that should match not only present vehicles but also the new generation ones. The new procedure will be introduced in the future.
In conclusion NHTSA said that Mobile Deformable Barrier, both left and right offset, would address the largest vehicle population with injured drivers. The full fixed barrier test would address a lower target population. All other potential tests, such as the Offset-Barrier EU Test, would address significantly lower target population.

Asked about the European views on the performance criteria and test procedure documents, the representative of EEVC suggested that the IHRA Biomechanics working group be asked for their advice about any progress on new criteria for frontal crash protection, taking into account the fact that the members of the frontal impact group were not experts in this specific topic.
Furthermore Mr. Lowne remarked that the goal of a potential candidate test procedure is to reduce the casualties and not to reproduce the most frequent accidents.
Mr. Hobbs added that it must be clear that the test method influences car design. Accordingly a proper method has to be devised to achieve a car design corresponding to the goals that we are focusing.

<u>Conclusion</u>

According to doc. AFC-15, from Japan, further test using vehicles with different weights at varied collision speeds and other factor than the collision speed are awaited.

DISCUSSION ON THE AGENDA OF THE MEETING

1. Extension to vehicle of category N1 (1st step)

OICA
Was invited last meeting to collect data from the market to define N1 subgroups.
OICA briefly presented some slides showing this categorization:
M1 2,5 - 3,5t include Minivan, Sport Utility Vehicles.
N1 1,3 - 1,4t / 2,3 - 3,5t
Other N1 vehicles
◆ Non integral
◆ Multi stage built
Mr. Fay pointed out also that the structural differences between vehicles heavier and lighter than 3,5t consisted in the fact that for vehicle until 3,5t the monocock construction is most used, when over that weight the frame construction prevails. He believed that the application of the offset deformable frontal impact test to N1 car-derivatives, which would be N1 vehicles up to about 2 tonnes, should present no problems. Panel vans above this mass may present problems.

EEVC
After reviewing former document AFC 16, concerning overviews on the issue of extension to vehicle of category N1, EEVC presented document IHRA AFC-18. The report concerning, frontal impacts , is sub section of an accident analysis for the review of the Frontal and Side Impact Directives on behalf of BASt, TNO, TRL, Volvo. The aim of this part was to consider these technical issues:

- Test speed
- The neck injury criteria
- The extension to N1 vehicles

From the review of accident data, sufficient evidence was found to suggest that neck injury criteria should be retained, an increase in the test speed should be considered and that N1 class vehicles be included in the test. In this study it is noted that relative to the total number passenger, the percentage of N1 vehicles increasing. The percentage of kilometres driven by the N1 class vehicle is also increasing.
From the presented data it can be seen that on average N1 class vehicle appears to be less lethal to their occupants than a passenger car (M1), but N1 class appears more aggressive than M1.
From the findings of the survey, the possible aggressive nature of N1 vehicles has been highlighted.

USA
Vehicles are categorized rather differently in the USA, being distinguished primarily by weight, with categories including “passenger car” and “light truck”

Conclusion
The Chairman requested that further analyses should be made (especially from different markets such as Australia and Japan) to implement the studies conducted so far.
The chairman also insisted about the developments of the barrier in relation to the new method and to the extension of vehicles of category N1.

2. Type of barrier

NHTSA
An overview of the NHTSA commitments in carrying out new tests, a new test to improve understanding of Frontal Crash Protection with regard Passenger Cars vs. LTV, is given.in doc. AFC17.
The Agency remarked that the test to reproduce the effect of a MDB test should get a procedure as simpler as possible. If such goal will be not achieved, NHTSA will adopt an FDB test.

The priorities of the Agency are to reduce:
1 Intrusion (induced injuries)
2 Deceleration (based injuries)
Mr. Hollowell clarified that in the case of the MDB test , it should be basically divided in two test concerning the overlap:
1. Stiff crash pulse intrusion (more overlap)
2. Soft crash pulse intrusion (less overlap)

Australia
The delegate presented document IHRA AFC 19. The document was related to the vehicle size and to the barrier frontal height. Accordingly in the document the vehicles were divided into three groups; Small, Medium and Large. For the design of an impact barrier, the most important of the measured frontal members were the upper dimension of the top and the lower dimension of the bottom crossmember, because they determine the height and ground clearance of the barrier.
Differences found between vehicles suggested that nose-dive was related to braking deceleration and suspension characteristics of the individual vehicle. Vehicle mass was not significant in its own right.

EEVC
Reported that EEVC WG.16 was not considering the revision of the existing fixed barrier design.
The prominent issue being considered by the group is a different mass of a mobile barrier with respect to those of the vehicles under tests.
This group has addressed their researches to:
- Practicability aspects (same masses for impact tests).
- Same mass with regard to that of a certain category of vehicle.
- Geometry is not considered.

The provisional conclusion was that the barrier mass should be the same for all cars tested, but that the subject was complicated and more research was needed.

Chairman
Suggested to revise the former table concerning the Trolley-based Frontal Offset Impact Test procedure, which after a brief discussion was changed as follows:

ADVANTAGES	**ALTERNATIVE APPROACH TO ACHIEVE SAME ADVANTAGE WITH FIXED BARRIER**
1. The acceleration pulse, DV and energy distribution is representative of real world serious injuries.	No known alternative.
2. Takes into account the effects of the Mass Ratio of the vehicles.	Change impact speed with vehicle mass.
3. Can include angular effects on the deformation and intrusion characteristics.	No known alternative.
4. Can include a possible measure of Compatibility (by, for instance, measuring the vehicle and/or trolley acceleration)	Measure the force on the fixed barrier behind the deformable face.
Disadvantages	**POSSIBLE ACTIONS TO REDUCE THE DISADVANTAGE**
1. Complex test procedure for "moving barrier-moving car" (such as high speed trolley bounce. Possible overriding and others).	) Reduce complexity by testing co-linearly and/or using moving barrier to stationary car. Explore methods of reducing artificial overriding.
2. Repeatability of more complex test may be poor (for angled moving barrier-moving car)	
3. Difficulties to video record impact effects between trolley and stationary car.	Mount the camera on the vehicle
4. Limited number of test laboratories with capability to perform trolley-to-vehicle testing.	Minimise the complexity of the test and/or improve capability of test institutes.
5. Unknown ground and other interaction effects, especially if one vehicle stationary while the other travels at higher speed – to represent both vehicles moving.	Investigate
6. Need to agree on a harmonised barrier mass, stiffness and geometry when vehicle fleet differ internationally.	Agree to differ

Conclusion
The chairman recommended that for type approval a simple procedure should be finalised and noted the suggestion of Mr. Lowne, who pointed out the need to consider the importance of the effects of

- collision angle (repeatability problems)
- mass
- compatibility

Furthermore the concern of Mr. Hobbs, regarding the difficulties to separate the definition of a new method from those of compatibility and biomechanic, was addressed to the group.

3. Impact speed

EEVC
With reference to doc. IHRA AFC 18, Mr. Lowne reported the results of the survey concerning this matter to the group. The study indicates that frontal impact test speed may need to be increased, in order to address frontal impact protection up to the severity which a reasonable proportion (approximately 50%) of seriously injured occupants are currently subjected. However, raising the test speed might lead to increase the vehicle's overall frontal stiffness. Accordingly injuries caused by higher deceleration could be envisaged. Therefore the accident data were split into those related to acceleration and those related to contact. The results for all samples showed that the contact injuries predominated, suggesting that an a higher test speed that resulted in a small increase in acceleration would be beneficial overall.
Furthermore, Mr. Lowne emphasised that the indicated speed of 64km/h is a test speed and not an accident velocity.

4. Performance Criteria

NHTSA
Mr. Hollowell presented document IHRA AFC 20, concerning performance criteria.
In response to the Congress Directive, to conduct a feasibility study toward establishing a FMVSS for frontal offset crash testing, a series of crash tests was performed. In the test series, all dummies 5^{th} percentile and 50^{th} percentile were tested with and without the safety belt systems. Three model years were used during the tests. Currently NHTSA is writing a report to the Congress .

Hobbs
Remarked the different approach of USA and Europe to the problem. USA looks at the severity oif the test method based on the dummy responses, while EU is focusing on how the method tests the car structural performance. Such differences should be taken into account in the definition of a new method.

EEVC
Suggested that this working group should identify the body areas for which performance criteria were required and ask the IHRA Biomechanics group and EEVC WG12 for advice on the performance criteria

Australia
Pointed out that currently the biomechanics group is concentrating on lateral impact studies.

Conclusion
According to Mr. Lowne and Mr. Hollowell a list of the body regions statistically most frequently seriously injured should be created with the aim of asking opinion of the experts how to assess them and which is the best test tool to use. Mr. Lowne will circulate within the group a complete list concerning the following topics:

ITEMS	TOOLS	CURRENT METHODS
HEAD	Head acceleration	HIC + Peak of acceleration
FACE	Force and pressure	No criteria
NECK	Pressure and forces	
UPPER LIMBS	Forces, moments, Angular and linear acceleration	
CHEST	Acceleration, compression, velocity of compression,	
THORACIC SPINE	Forces moment and acceleration	
ABDOMEN	Pressure, compression, velocity of compression.	
LUMBAR SPINE	Angular displacement, forces, moments and acceleration.	
PELVIS/FEMUR/KNEE	Forces, compression, shear (pelvis accel.)	
LOWER LEG	Forces axial/shear, moment	
FOOT ANKLE	Acceleration: load, moment angle.	

Mr. Hobbs

Presented the proposal, developed by EEVC WG16 for the measurement of footwell intrusion and that will be assessed for use within EU-NCAP.

The intrusion of the brake pedal is measured with respect to a reference line passing through the pedal and inclined of 56°. This first geometric approach will be implemented for data collected during the next NCAP tests and it will be possibly modified.

5. Air-Bag performance

NHTSA

The delegate from NHTSA informed about the tests conducted to investigate about the trauma induced when the vehicle occupant is in close proximity to the deploying airbag.

The data collected from these tests suggest that the new Combined Thorax Index (CTI) is a good discriminator between more aggressive and less aggressive air bags.

The tests were conducted in comparing vehicles equipped with air-bag pre 1998 and 1998. The results showed that all the 1998 air-bags appeared less aggressive to the chest than the corresponding pre-1998 air bags.

Other tests concerning out of position were conducted to investigate the trauma induced when the child dummy is in close proximity to the deploying airbag.

Baseline tests were conducted with original airbag inflators while corresponding depowered tests were conducted using the same airbag module, but with some propellent removed from the inflator.

This decrease in aggressivity is correlated with a decrease in the proposed thoracic injury criteria, suggesting that these criteria predict injury risk for children reasonably well.

Other topics concerning airbag and related performance criteria are included into document AFC 14.

Furthermore, answering the question of the chairman concerning the 5^{th} percentile female dummy, NHTSA stated that the agency is concerned about a test velocity of 40 km/h as a first step. Regarding the dummy, the agency is still evaluating pros and cons.

EEVC

As far as the European regulatory conditions are concerned, EEVC saw the maximum benefit from using the 50^{th} percentile dummy for the first step.

For a second test, according to NHTSA suggestions, EEVC will enquiry for feasibility and opportunity to do use the 5^{th} percentile

OICA

Remarked once more the differences between Europe and USA, because the Air-Bag has been introduced in Europe in a second step for restrained occupants. In most of all the US cases the Air-Bag system is set to protect the unrestrained occupant. This different philosophy has led to much more powerful Air-Bag in USA and less powerful in Europe.

Moreover the delegate of the industry suggested that the adoption of 5^{th} percentile female test would not lower the aggressivity of the Air-Bag, but simply change the threshold of firing. An Air-Bag fitted for a 5^{th} percentile female can not necessarily be safe for other category of occupants.

Chairman
Reminded that statistic on injuries induced by the Air-bag are available. On this base, an European approach on the Air-Bag performance should be advisable.

6. Impact angle

NHTSA
According to paper IHRA AFC 13, the MDB test is devoted to assess severe oblique real crash accident with significant intrusion and frontal engagement. Tests led by NHTSA, demonstrated that this methodology produces significant intrusion in smaller and lighter vehicles. The suggested angle of entry of the trolley has been reduced to 20°, based on the discussions within this wg.
Anyway, the agency announced that the next papers from NHTSA will regard the level of overlap, the level of angle influence, displacement of the dummy and impact of this last with the Air-Bag.

7. Conclusion of the meeting

Point 7 and 8 were already involved and examined into the discussion.
The date of the next meeting was roughly scheduled for July 1999.

LIST OF CLASSIFIED DOCUMENTS

- **IHRA/AFC-13 Review of Potential Test Procedures for FMVSS No. 208 (S. Stucki, W.T. Hollowell, H.C.Gabler, S. Summers, J.R.Hackney)**
- **IHRA/AFC-14 Development of Improved Injury Criteria for the Assessment of Advanced Automotive Restraint Systems (M.Kleinberger, E.Sun, R. Eppinger, S.Kuppa, R.Saul).**
- **IHRA/AFC-15 Real Conditions of Japanese Road Traffic and Traffic Accident (K. Oki)**
- **IHRA/AFC-16 UN and EU Vehicle Category Definitions**
- **IHRA/AFC-17 Improved Frontal Crash Protection: Passenger Cars and LTV'S**
- **IHRA/AFC-18 Accident Analyses for the Review of the Frontal and Side Impact Directives**
- **IHRA/AFC-19 Australia study on vehicle Nose-Dive.**
- **IHRA/AFC-20 Frontal Offset Crash Test Study Using the 50^{th} Percentile Male and 5^{th} Percentile Female Dummies**
- **IHRA/AFC-21 Deflection Characteristics of EEVC and ADAC Frontal impact Barriers**